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HOBART COLLEGE BULLETINS

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Proceedings of Commencement
Phi Beta Kappa Address
Resignation of President Stewardson

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PROCEEDINGS OF COMMENCEMENT

The Commencement of nineteen hundred and twelve was distinctive in that it was the Eighty-seventh Commencement of Hobart College and the First of William Smith. It was largely attended by alumni, former students and guests. Only one fact detracted from the pleasure of the week, the inability of the President to be present. He had hoped to be in Geneva but the condition of Mrs. Stewardson's health made it impossible for him to return. Many were the anxious inquiries for them both and many the expressions of sympathy and regret. Monday and Tuesday were devoted largely to William Smith College and Wednesday and Thursday to Hobart. The William Smith Baccalaureate sermon was preached in the First Presbyterian Church by the Reverend George B. Stewart, D.D., of Auburn Theological Seminary. It will be recalled that in the early days of the College, Commencement exercises of Geneva College were held in the old Presbyterian Church which stood on the site of the present church. The Hobart Baccalaureate sermon was delivered as usual in Trinity Church on Sunday evening. The Reverend John P. Peters, D.D., of St. Michael's Church, New York City, was the preacher.

Preceding the class day exercises of William Smith College on Monday forenoon there was unveiled in Smith Hall a bronze tablet, the gift of the Senior class. It bears the inscription, "To the memory of William Smith, the founder of the college. Presented by the charter class, 1912." Dean Turk, on behalf of the class, made the address of presentation and Mr. Graves, on behalf of the Board of Trustees, accepted it with appropriate remarks on certain characteristics and ideals of Mr. Smith. The class day exercises were held in the grove and included among other things the planting of the class tree. In the afternoon the students of William Smith College presented "Pygmalion and Galatea" on the campus.

Tuesday afternoon after luncheon, which was served on the lawn in front of Miller house, the Commencement procession formed in front of the dormitories and, led by the undergraduate body, proceeded to Coxe Hall where the exercises were held. The Commencement address was delivered by the Reverend Rob Roy MacGregor Converse, LL.D., of Rochester, who spoke on the Ideal of Womanhood. Dean Turk presented the candidates for degrees, concluding his remarks by reading a letter from President Stewardson expressing his regret at not being able to confer the degrees on the first class. Acting President Durfee conferred the degrees on the class of 1912 and upon Mrs. George Haven Putnam, the honorary degree of L.H.D.

Wednesday was alumni day for Hobart College and on that day were held the meetings of the Trustees and the associate alumni, and in the evening the alumni smoker. This was well attended, and much enthusiasm was aroused by the presence of the class of 1882, a large percentage of the class being present for the reunion.

On Thursday the Commencement procession was formed at the Library by General William Wilson, '76, as Marshal. Thence the procession proceeded to the Opera House. The Latin Salutatory was delivered by Henry A. Post of Hoboken, N. J. The Phi Beta Kappa orator was Frederick W. Taylor, M.E., Sc.D., of Philadelphia who spoke on Scientific Management. An account of his address is included elsewhere in this bulletin. Acting-President Durfee announced the honors and prizes for the year and conferred the degrees in course upon the graduating class. Professor Woodman then presented the candidates for honorary degrees as follows, and Professor Durfee conferred the degrees.

Mr. President:

In behalf of the Board of Trustees of Hobart College, I have the pleasure of presenting the following candidates for honorary degrees:

For the degree of Master of Arts, JOHN BURT, of the class of 1859; though a non-graduate, a devoted son of his alma mater, a skillful lawyer of New York City, whose scholarship and integrity are widely recognized by his colleagues at the bar.

For the degree of Doctor of Sacred Theology, the Reverend FRANK CLARENCE COOLBAUGH; alumnus of this college in the class of 1866; scholar, preacher, Christian gentleman, who, in a long life of service in northern Minnesota, has endeared himself to clergy and people, and has extended far beyond parochial limits the influence both in Church and State of a man of large-hearted interest in the moral, intellectual, and spiritual uplift of life.

And for the same degree of Doctor of Sacred Theology, the Reverend GEORGE BLACK STEWART; preacher, teacher, and theologian; president of the Auburn Theological Seminary; a founder and one-time president of the Chautauqua Society; co-worker in many religious and educational organizations throughout the country; author of scholarly books in his special field; widely known as a servant of liberal Christianity, of sound learning, and of his fellow-men.

And for the degree of Doctor of Humane Letters, DAVID MCGREGOR MEANS; able teacher and practitioner of the law, lecturer, man of letters, who, by important books and essays, has thrown much light on the urgent civic, industrial, and economic problems that confront us to-day.

And for the degree of Doctor of Laws, FREDERICK WINSLOW TAYLOR; distinguished inventor and engineer, who has applied the knowledge gained in a long and difficult series of experiments during a successful career in the Midvale Steel Works to creating a new and revolutionary science of industrial efficiency. This science he has not only ably set forth in published writings known to all the world but has also put in practice as organizer of many great manufacturing establishments, performing thereby a service which benefits alike employer and employed.

And for the same degree of Doctor of Laws, the Reverend ROB ROY MACGREGOR CONVERSE; Rector of St. Luke's Parish, Rochester; one-time chaplain of Hobart College, where for ten years as teacher and pastor he endeared himself to students and faculty; the guide, philosopher, and friend of many of us; who still remains our beloved friend and helper; a man that Hobart ever delighteth to honor.

The alumni dinner was held in Coxe Hall and was a large and enthusiastic gathering. The Reverend Gustav A. Carstensen, '73, president of the associate alumni, presided. Among those who spoke were Acting-President Durfee, Reverend George B. Stewart, Reverend F. C. Coolbaugh, '66, Henry A. Prince, '82, Dr. Joseph T. Taylor, '92, and R. F. O'Hora, '12.

PHI BETA KAPPA ADDRESS

JUNE 20TH, 1912

BY FREDERICK WINSLOW TAYLOR, M.E., SC.D.

Ladies and Gentlemen, Mr. President:

I am going to speak upon scientific management, and try to explain the principles of scientific management. Inasmuch as management refers to men and inasmuch as most of the illustrations which I propose giving today refer to workingmen, I wish to state that whenever I am speaking of workingmen I have in mind merely that class of workingmen who belong to coördinated industries. I do not refer to the isolated worker, but I refer to men who are working in the moderate walks of coöperative industries such as are to be found in our manufactories, our building trades, etc.

The most important fact connected with the working people of this country—and even more of the working people in England, largely of the working people of the entire civilized world—I say without hesitation the most important and significant factor connected with these workmen now is the fact that they all, practically, believe that it is for their interest to go slowly instead of fast; to do as little work as possible in a day instead of as much work as possible in a day; to make their employers believe they are working at a fast pace while, in fact, they are doing as little as they reasonably can in a day. Now this sounds like a severe arraignment, like a dis-

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This address was delivered without manuscript and at the suggestion of Dr. Taylor, the report here given has been prepared by using largely extracts from his "Principles of Scientific Management." No attempt has been made to indicate this by the use of quotation marks.

agreeable accusation of workingmen. It is nothing of the kind. They have merely adopted this policy after the most careful thought and consideration; and I think that if you and I were in their places we would probably very likely adopt the same policy. The causes of this belief on the part of the workman that it is for his interest to go slowly, that it is for his interest to turn out as small an amount of work as possible, are two-fold:

First. The great majority of workmen still believe that if they were to work at their best speed they would be doing a great injustice to the whole trade by throwing a lot of men out of work, and yet the history of the development of each trade shows that each improvement, whether it be the invention of a new machine or the introduction of a better method, which results in increasing the productive capacity of the men in the trade and cheapening the costs, instead of throwing men out of work makes in the end work for more men.

The cheapening of any article in common use almost immediately results in a largely increased demand for that article. Take the case of shoes, for instance. The introduction of machinery for doing every element of the work which was formerly done by hand has resulted in making shoes at a fraction of their former labor cost, and in selling them so cheap that now almost every man, woman, and child in the working-classes buys one or two pairs of shoes per year, and wears shoes all the time, whereas formerly each workman bought perhaps one pair of shoes every five years, and went barefoot most of the time, wearing shoes only as a luxury or as a matter of the sternest necessity. In spite of the enormously increased output of shoes per workman, which has come with shoe machinery, the demand for shoes has so increased that there are relatively more men working in the shoe industry now than ever before.

The workmen in almost every trade have before them an object lesson of this kind, and yet, because they are ignorant of the history of their own trade even, they still firmly believe, as their fathers did before them, that it is against their best interests for each man to turn out each day as much work as possible.

Under this fallacious idea a large proportion of the workmen of both countries each day deliberately work slowly so as to curtail the output. Almost every labor union has made, or is contemplating making, rules which have for their object curtailing the output of their members, and those men who have the greatest influence with the working-people, the labor leaders as well as many people with philanthropic feelings who are helping them, are daily spreading this fallacy and at the same time telling them that they are overworked.

A great deal has been and is being constantly said about "sweat-shop" work and conditions. The writer has great sympathy with those who are overworked, but on the whole a greater sympathy for those who are *under paid*. For every individual, however, who is overworked, there are a hundred who intentionally underwork—greatly underwork—every day of their lives, and who for this reason deliberately aid in establishing those conditions which in the end inevitably result in low wages. And yet hardly a single voice is being raised in an endeavor to correct this evil.

Second. As to the second cause for soldiering—the relations which exist between employers and employees under almost all of the systems of management which are in common use—it is impossible in a few words to make it clear to one not familiar with this problem why it is that the *ignorance of employers* as to the proper time in which work of various kinds should be done makes it for the interest of the workman to "soldier."

The writer, therefore, quotes herewith from a paper read before the American Society of Mechanical Engineers, in June, 1903, entitled "Shop Management," which it is hoped will explain fully this cause for soldiering:

"This loafing or soldiering proceeds from two causes. First, from the natural instinct and tendency of men to take it easy, which may be called natural soldiering. Second, from more intricate second thought and reasoning caused by their relations with other men, which may be called systematic soldiering.

"There is no question that the tendency of the average man (in all walks of life) is toward working at a slow, easy gait, and that it is only after a good deal of thought and observation on his part or as a result of example, conscience, or external pressure that he takes a more rapid pace.

"There are, of course, men of unusual energy, vitality, and ambition who naturally choose the fastest gait, who set up their own standards, and who work hard, even though it may be against their best interests. But these few uncommon men only serve by forming a contrast to emphasize the tendency of the average.

"This common tendency to 'take it easy' is greatly increased by bringing a number of men together on similar work and at a uniform standard rate of pay by the day.

"Under this plan the better men gradually but surely slow down their gait to that of the poorest and least efficient. When a naturally energetic man works for a few days beside a lazy one, the logic of the situation is unanswerable. 'Why should I work hard when that lazy fellow gets the same pay that I do and does only half as much work?'

"A careful time study of men working under these conditions will disclose facts which are ludicrous as well as pitiable.

"To illustrate: The writer has timed a naturally energetic workman who, while going and coming from work, would walk at a speed of from three to four miles per hour, and not infrequently trot home after a day's work. On arriving at his work he would immediately slow down to a speed of about one mile an hour. When, for example, wheeling a loaded wheelbarrow, he would go at a good fast pace even up hill in order to be as short a time as possible under load, and immediately on the return walk slow down to a mile an hour, improving every opportunity for delay short of actually sitting down. In order to be sure not to do more than his lazy neighbor, he would actually tire himself in his effort to go slow.

"These men were working under a foreman of good reputation and highly thought of by his employer, who, when his attention was called to this state of things, answered: 'Well, I can keep them from sitting down, but the devil can't make them get a move on while they are at work.'

"The natural laziness of men is serious, but by far the greatest evil from which both workmen and employers are suffering is the *systematic soldiering* which is almost universal under all of the ordinary schemes of management and which results from a careful study on the part of the workmen of what will promote their best interests

"The writer was much interested recently in hearing one small but experienced golf caddy boy of twelve explaining to a green caddy, who had shown special energy and interest, the necessity of going slow and lagging behind his man when he came up to the ball, showing him that since they were paid by the hour, the faster they went the less money they got, and finally telling him that if he went too fast the other boys would give him a licking.

"This represents a type of *systematic soldiering* which is not, however, very serious, since it is done with the knowledge of the employer, who can quite easily break it up if he wishes.

"The greater part of the *systematic soldiering*, however, is done by the men with the deliberate object of keeping their employers ignorant of how fast work can be done.

"So universal is soldiering for this purpose that hardly a competent workman can be found in a large establishment, whether he works by the day or on piece work, contract work, or under any of the ordinary systems, who does not devote a considerable part of his time to studying just how slow he can work and still convince his employer that he is going at a good pace.

"The causes for this are, briefly, that practically all employers determine upon a maximum sum which they feel it is right for each of their classes of employees to earn per day, whether their men work by the day or piece.

"Each workman soon finds out about what this figure is for his particular case, and he also realizes that when his employer is convinced that a man is capable of doing more work than he has done, he will find sooner or later some way of compelling him to do it with little or no increase of pay.

"Employers derive their knowledge of how much of a given class of work can be done in a day from either their own experience, which has frequently grown hazy with age, from casual and unsystematic observation of their men, or at best from records which are kept, showing the quickest time in which each job has been done. In many cases the employer will feel almost certain that a given job can be done faster than it has been, but he rarely cares to take the drastic measures necessary to force men to do it in the quickest time, unless he has an actual record proving conclusively how fast the work can be done.

"It evidently becomes for each man's interest, then, to see that no job is done faster than it has been in the past. The younger and less experienced men are taught this by their elders, and all possible persuasion and social pressure is brought to bear upon the greedy and selfish men to keep them from making new records which result in temporarily increasing their wages, while all those who come after them are made to work harder for the same old pay.

"Under the best day work of the ordinary type, when accurate records are kept of the amount of work done by each man and of his efficiency, and when each man's wages are raised as he improves, and those who fail to rise to a certain standard are discharged and a fresh supply of carefully selected men are given work in their places, both the natural loafing and systematic soldiering can be largely broken up. This can only be done, however, when the men are thoroughly convinced that there is no intention of establishing piece work even in the remote future, and it is next to impossible to make men believe this when the work is of such a nature that they believe piece work to be practicable. In most cases their fear of making a record which will be used as a basis for piece work will cause them to soldier as much as they dare.

"It is, however, under piece work that the art of systematic soldiering is thoroughly developed; after a workman has had the price per piece of the work he is doing lowered two or three times as a result of his having worked harder and increased his output, he is likely entirely to lose sight of his employer's side of the case and become imbued with a grim determination to have no more cuts if soldiering can pervent it. Unfortunately for the character of the workman, soldiering involves a deliberate attempt to mislead and deceive his employer, and thus upright and straightforward workmen are compelled to become more or less hypocritical. The employer is soon looked upon as an antagonist, if not an enemy, and the mutual confidence which should exist between a leader and his men, the enthusiasm, the feeling that they are all working for the same end and will share in the result in entirely lacking.

"The feeling of antagonism under the ordinary piecework system becomes in many cases so marked on the part of the men that any proposition made by their employers, however reasonable, is looked upon with suspicion, and soldiering becomes such a fixed habit that men will frequently take pains to restrict the product of machines which they are running when even a large increase in output would involve no more work on their part."

Now it was in an earnest endeavor to remedy this evil of soldiering that the first steps were taken, about thirty years ago, which have led toward the evolution which is now called scientific management. It was an earnest endeavor to remedy the evils of soldiering that marked the first steps in scientific management and far from being a theory, a new theory which has been invented by any one man or any hundred men and which is now being tried on the country or tried anywhere, scientific management has, in its every step, been an evolution; every step has been taken in a carefully made endeavor to remedy some of the glaring defects in existing management. Not a single step has been taken as the result of some pre-conceived theory of some one. Now I want to emphasize this because personally I have a profound suspicion of all new theories, my own as well as any one else's. Of all new theories I have a profound suspicion. Nineteen out of every twenty I say are wrong, new and untried theories; so I want to make it clear that scientific management does not belong in that class. It is an evolution. So far from being a theory, it is only within the last few years anyone has tried to analyze scientific management, tried to find out what theory it is, only during the last few years, though it has been in evolution for thirty years, and there are no less than fifty thousand men working under the principles of scientific management, and the output of the men in the companies that have come under scientific management has on the average been doubled—probably more than doubled, but certainly doubled. As a result of this increase in output the product has been produced very much cheaper than it was before. That has resulted in two things generally; in the somewhat lowering of the selling price of the article, not always but sometimes, and invariably in a larger profit to the manufacturer, the owner of the company, so that the manufacturer's profit through larger dividends, the public has profited through a reduction in cost, and that is what the whole world is getting at, the benefit of it. You and I and the whole world benefit in any increase in output, bringing more riches into the world and making them available for us.

But the greatest good of all has come to the workmen. The workmen under scientific management are receiving invariably from 30 to 100 per cent higher wages than are paid similar trades working right around them, right in adjoining factories. Two brothers work—exact mates: one works under scientific management and the other under the ordinary old management, and the one under scientific management earns 30 to 100 per cent higher wages than the other man does. But with perfect confidence, I say this is far from being the greatest good that has come to the workman. The greatest good that has come to him is that he has learned to coöperate in the most friendly way with his employer; that he has come to look upon his employer as the best friend that he has in the world. Now that may sound rather curious in view of all the strikes and the bitter talk and the class feeling that is being stirred up between workingmen and employers; that sounds like an exaggeration, to say the least. Let me tell you some facts that will justify that statement. In thirty years and over, scientific management has been introduced in perhaps a hundred trades, more than that, in a hundred different types of establishments and most of them in competitive industries, industries in all of which there have been repeated strikes under the old type of management. There has never until last summer been a single strike of men working under scientific management, never a single strike in 30 years in any industry until the Moulders' Union, without giving it one day's trial, in the Watertown Arsenal struck and went out. I think they were back in four or five days and are now working and have been ever since under scientific management.

What is scientific management? I think I can sweep the deck somewhat, by first saying what it is not; by pointing out what scientific management is not. Scientific management is not any so-called efficiency device, nor any group of efficiency devices; it is not any new cost system, new system of figuring costs; it is not any new scheme for paying men, no piece-work system; it is not printing and unloading on the establishment a ton or two of printed matter of all kinds and sorts and saying, "Now there is your system, go ahead and use it;" it is not time study, that is, it is not running around with a stop-watch and watching workmen and then writing down what they are doing; it is no functional or divided foremanship. All of these elements, all of these items that I have spoken of, are elements of scientific management. They are all useful when properly applied under scientific management. Some of them have been the evolution—entirely an evolution, of scientific management that did not exist before. I am not sneering at nor sneering against any of those things, but I want to emphasize the fact that scientific management is none of these things nor is it all of these things put together. There is no device in its essence.

Scientific management involves a complete mental and moral revolution on the part of the workmen, on the part of the men in their viewpoint as to their relations with one another and with their employers, and an equal and great revolution on the part of employers with relation to their duties to the men—to their own duties. In its essence then, scientific management cannot exist without this complete mental revolution on the part of both workmen and employers. I am quite aware that sounds, perhaps, high-falutin, perhaps blind. I will not try to explain what I mean by this mental revolution. Let me give just one illustration of what I mean by it. Into the manufacture of every article that is sold there goes a certain amount of material. Then there goes beside that a certain amount of general expenses,—sales expenses, the money that has to be paid to men to advertise and sell it, the money that has to be paid for power, for light, for heat, for material to manufacture this, for all sorts of items that may be called general expense; and then in addition to that there are two other items enter into the manufacture of that, or rather, into the sale of that. If we deduct, then, the cost of the raw materials and the cost of the general expense from the price at which this article is sold, there is a certain surplus left over. After deducting material cost, and general expense cost, there is a certain surplus left over from the selling price and almost all of the disputes that have occurred and are occurring between employer and employee are over the division of this surplus that is left over after deducting material and general expenses from selling price. The workmen are trying to get as much as possible of that surplus in the form of wages and the employer is trying to get as large a share of that surplus as possible in the shape of profits. That is the great dispute between capital and labor. There are other items,—hours of labor, working conditions—but the main dispute has and always will be under the old type of management in regard to the division of the surplus, the workman wanting all that he can get of it in the shape of wages and the employer as large a profit as he can get. The minds of both sides then have been centered on the division of that surplus. The mental attitude of both sides; that is what they are looking at; that is what they are quarrelling over.

Now let me point out the great mental revolution that takes place under scientific management. Under scientific management both sides are gradually taught to take their eyes off the division of this surplus. That is one of the great mental changes that takes place. They take their mind off the division, the quarrel, the fight, the wrangle over this surplus and set together to coöperate in the most hearty, friendly, genuine way to make that surplus so large that both sides can get a great deal more than they were able to before. That is one great mental change that takes place,—a total change in outlook. They realize that by stopping their quarreling, by diverting their energy from strife, from hard feelings, from bitter talk, to friendliness, to coöperation, they can make that surplus so large that there is no need to fight. That is one of the great mental changes and without that change scientific management does not exist. You may have all the outward forms of it, all your mechanism, but it is not scientific management until both sides have had not only that mental revolution but many others. In addition to this change in mental attitude, both sides must agree that exact knowledge is substituted for some one's opinions; substitution of exact knowledge by both sides for some one's opinion is necessary in addition to this great change in the mental attitude of both sides.

Before starting to illustrate the principles of scientific management, or "task management" as it is briefly called, it seems desirable to outline what the writer believes will be recognized as the best type of management which is in common use. This is done so that the great difference between the best of the ordinary management and scientific management may be fully appreciated.

In an industrial establishment which employs say from 500 to 1000 workmen, there will be found in many cases at least twenty to thirty different trades. The workmen in each of these trades have had their knowledge handed down to them by word of mouth, through the many years in which their trade has been developed from the primitive condition, in which our far-distant ancestors each one practised the rudiments of many different trades, to the present state of great and growing subdivision of labor, in which each man specializes upon some comparatively small class of work.

The ingenuity of each generation has developed quicker and better methods for doing every element of the work in every trade. Thus the methods which are now in use may in a broad sense be said to be an evolution representing the survival of the fittest and best of the ideas which have been developed since the starting of each trade. However, while this is true in a broad sense, only those who are intimately acquainted with each of these trades are fully aware of the fact that in hardly any element of any trade is there uniformity in the methods which are used. Instead of having only one way which is generally accepted as a standard, there are in daily use, say, fifty or a hundred different ways of doing each element of the work. And a little thought will make it clear that this must inevitably be the case, since our methods have been handed down from man to man by word of mouth, or have, in most cases, been almost unconsciously learned through personal observation. Practically in no instances have they been codified or systematically analyzed or described.

The ingenuity and experience of each generation—of each decade, even, have without doubt handed over better methods to the next. This mass of rule-of-thumb or traditional knowledge may be said to be the principal asset or possession of every tradesman. Now, in the best of the ordinary types of management, the managers recognize frankly the fact that the 500 or 1000 workmen, included in the twenty to thirty trades, who are under them, possess this mass or traditional knowledge, a large part of which is not in the possession of the management. The management, of course, includes foremen and superintendents, who themselves have been in most cases first-class workers at their trades. And yet these foremen and superintendents know, better than anyone else, that their own knowledge and personal skill falls far short of the combined knowledge and dexterity of all the workmen under them. The most experienced managers,therefore, frankly place before their workmen the problem of doing the work in the best and most economical way. They recognize the task before them as that of inducing each workman to use his best endeavors, his hardest work, all his traditional knowledge, his skill, his ingenuity, and his good-will—in a word, his "initiative," so as to yield the largest possible return to his employer. The problem before the management, then, may be briefly said to be that of obtaining the best *initiative* of every workman. And the writer uses the word "initiative" in its broadest sense, to cover all of the good qualities sought for from the men.

On the other hand, no intelligent manager would hope to obtain in any full measure the initiative of his workmen unless he felt that he was giving them something more than they usually receive from their employers.

Only those among the readers of this paper who have been managers or who have worked themselves at a trade realize how far the average workman falls short of giving his employer his full initiative. It is well within the mark to state that in nineteen out of twenty industrial establishments the workmen believe it to be directly against their interests to give their employers their best initiative, and that instead of working hard to do the largest possible amount of work and the best quality of work for their employers, they deliberately work as slowly as they dare while at the same time try to make those over them believe that they are working fast.

The writer repeats, therefore, that in order to have any hope of obtaining the initiative of his workmen the manager must give some special incentive to his men beyond that which is given to the average of the trade. This incentive can be given in several different ways, as, for example, the hope of rapid promotion or advancement; higher wages, either in the form of generous piece work prices or of a premium or bonus of some kind for good and rapid work; shorter hours of labor; better surroundings and working conditions than are ordinarily given, etc., and, above all, this special incentive should be accompanied by that personal consideration for, and friendly contact with, his workmen which comes only from a genuine and kindly interest in the welfare of those under him. It is only by giving a special inducement or "incentive" of this kind that the employer can hope even approximately to get the "initiative" of his workmen. Under the ordinary type of management the necessity for offering the workman a special inducement has come to be so generally recognized that a large proportion of those most interested in the subject look upon the adoption of some one of the modern schemes for paying men (such as piece work, the premium plan, or the bonus plan, for instance) as practically the whole system of management. Under scientific management, however, the particular pay system which is adopted is merely one of the subordinate elements.

Broadly speaking, then, the best type of management in ordinary use may be defined as management in which the workmen give their best initiative and in return receive some special incentive from their employers. This type of management will be referred to as the management of "initiative and incentive" in contradistinction to scientific management, or task management, with which it is to be compared.

The writer hopes that the management of "initiative and incentive" will be recognized as representing the best type in ordinary use, and in fact he believes that it will be hard to persuade the average manager that anything better exists in the whole field than this type. The task which the writer has before him, then, is the difficult one of trying to prove in a thoroughly convincing way that there is another type of management which is not only better but overwhelmingly better than the management of "initiative and incentive."

The universal prejudice in favor of the management of "initiative and incentive" is so strong that no mere theoretical advantages which can be pointed out will be likely to convince the average manager that any other system is better. It will be upon a series of practical illustrations of the actual working of the two systems that the writer will depend in his efforts to prove that scientific management is so greatly superior to other types. Certain elementary principles, a certain philosophy, will, however, be recognized as the essence of that which is being illustrated in all of the practical examples which will be given. And the broad principles in which the scientific system differs are so simple in their nature that it seems desirable to describe them before starting with the illustrations.

Under the old type of management success depends almost entirely upon getting the "initiative" of the workmen, and it is indeed a rare case in which this initiative is really attained. Under scientific management the "initiative" of the workmen (that is, their hard work, their good-will, and their ingenuity) is obtained with absolute uniformity and to a greater extent than is possible under the old system; and in addition to this improvement on the part of the men, the managers assume new burdens, new duties, and responsibilities never dreamed of in the past. The managers assume, for instance, the burden of gathering together all of the traditional knowledge which in the past has been possessed by the workmen and then of classifying, tabulating, and reducing this knowledge to rules, laws, and formulae which are immensely helpful to the workmen in doing their daily work. In addition to developing a science in this way, the management take on three other types of duties which involve new and heavy burdens for themselves.

These new duties are grouped under four heads:

First. They develop a science for each element of a man's work, which replaces the old rule-of-thumb method.

Second. They scientifically select and then train, teach and develop the workman, whereas in the past he chose his own work and trained himself as best he could.

Third. They heartily coöperate with the men so as to insure all of the work being done in accordance with the principles of the science which has been developed.

Fourth. There is an almost equal division of the work and the responsibility between the management and the workmen. The management takes over all work for which they are better fitted than the workmen, while in the past almost all of the work and the greater part of the responsibility were thrown upon the men.

It is this combination of the initiative of the workmen, coupled with the new types of work done by the management, that makes scientific management so much more efficient than the old plan.

Three of these elements exist in many cases, under the management of "initiative and incentive," in a small and rudimentary way, but they are, under this management, of minor importance, whereas under scientific management they form the very essence of the whole system.

The fourth of these elements, "an almost equal division of the responsibility between the management and the workmen," requires further explanation. The philosophy of the management of "initiative and incentive" makes it necessary for each workman to bear almost the entire responsibility for the general plan as well as for each detail of his work, and in many cases for his implements as well. In addition to this he must do all of the actual physical labor. The development of a science, on the other hand, involves the establishment of many rules, laws, and formulae which replace the judgment of the individual workman and which can be effectively used only after having been systematically recorded, indexed, etc. The practical use of scientific data also calls for a room in which to keep the books, records, etc., and a desk for the planner to work at. Thus all of the planning which under the old system was done by the workman, as a result of his personal experience, must of necessity under the new system be done by the management in accordance with the laws of the science; because even if the workman were well suited to the development and use of scientific data, it would be physically impossible for him to work at his machine and at a desk at the same time. It is also clear that in most cases one type of man is needed to plan ahead and an entirely different type to execute the work.

The man in the planning room, whose specialty under scientific management is planning ahead, invariably finds that the work can be done better and more economically by a subdivision of the labor; each act of each mechanic, for example, should be preceded by various preparatory acts done by other men. And all of this involves, as we have said, "an almost equal division of the responsibility and the work between the management and the workman."

To summarize: Under the management of "initiative and incentive" practically the whole problem is "up to the workman," while under scientific management fully one-half of the problem is "up to the management."

Perhaps the most prominent single element in modern scientific management is the task idea. The work of every workman is fully planned out by the management at least one day in advance, and each man receives in most cases complete written instructions, describing in detail the task which he is to accomplish, as well as the means to be used in doing the work. And the work planned in advance in this way constitutes a task which is to be solved, as explained above, not by the workman alone, but in almost all cases by the joint effort of the workman and the management. This task specifies not only what is to be done but how it is to be done and the exact time allowed for doing it. And whenever the workman succeeds in doing his task right, and within the time limit specified, he receives an addition of from 30 per cent to 100 per cent to his ordinary wages. These tasks are carefully planned, so that both good and careful work are called for in their performance, but it should be distinctly understood that in no case is the workman called upon to work at a pace which would be injurious to his health. The task is always so regulated that the man who is well suited to his job will thrive while working at this rate during a long term of years and grow happier and more prosperous, instead of being overworked. Scientific management consists very largely in preparing for and carrying out these tasks.

The writer is fully aware that to, perhaps, most of the readers of this paper the four elements which differentiate the new management from the old will at first appear to be merely high-sounding phrases; and he would again repeat that he has no idea of convincing the reader of their value merely through announcing their existence. His hope of carrying conviction rests upon demonstrating the tremendous force and effect of these four elements through a series of practical illustrations. It will be shown, first that they can be applied absolutely to all classes of work, from the most elementary to the most intricate; and second, that when they are applied, the results must of necessity be overwhelmingly greater than those which it is possible to attain under the management of initiative and incentive.

Now I shall begin with the lowest order or work that is known; that is, the simplest, the most elementary work that can be done that I know of that is done by men. I take that illustration first because most persons will not believe that there is any such thing as a science of doing the most elementary kind of work which can be done,—the handling of pig iron. Why? Because that man with his hands and another employee with his hands stoops down and picks up a piece of pig iron weighing about 90 pounds, lifts it, walks a few feet with it or a few yards and drops it, it is pretty difficult to believe there is a great science in it. It is an illustration that takes too long. I could show you thoroughly that the science of handling pig iron is so great that a man who is fit to work under it cannot possibly understand the science of it and that is true of almost every trade. I want to repeat that and I want to make it emphatic. It is true of almost every trade, that the science of doing the work in that trade is so great that a workman who is fit to work at the trade cannot understand that science. Pig iron is too long, however. Now, shoveling: the average man would question whether there is much of any science in the work of shoveling. Yet there is but little doubt, if any intelligent reader of this paper were deliberately to set out to find what may be called the foundation of the science of shoveling, that with perhaps 15 to 20 hours of thought and analysis he would be almost sure to have arrived at the essence of this science. On the other hand, so completely are the rule-of-thumb ideas still dominant that the writer has never met a single shovel contractor to whom it had ever occurred that there was such a thing as the science of shoveling. This science is so elementary as to be almost self-evident.

For a first-class shoveler there is a given shovel load at which he will do his biggest day's work. What is this shovel load? Will a first-class man do more work per day with a shovel load of 5 pounds, 10 pounds, 15 pounds, 20, 25, 30, or 40 pounds? Now this is a question which can be answered only through carefully made experiments. By first selecting two or three first-class shovelers, and paying them extra wages for doing trustworthy work, and then gradually varying the shovel load and having all the conditions accompanying the work carefully observed for several weeks by men who were used to experimenting, it was found that a first-class man would do his biggest day's work with a shovel load of about 21 pounds. For instance, that this man would shovel a larger tonnage per day with a 21-pound load than with a 24-pound load or than with an 18-pound load on his shovel. It is, of course, evident that no shoveler can always take a load of exactly 21 pounds on his shovel, but nevertheless, although his load may vary 3 or 4 pounds one way or the other, either below or above the 21 pounds, he will do his biggest day's work when his average for the day is about 21 pounds.

The writer does not wish it to be understood that this is the whole of the art or science of shoveling. There are many other elements, which together go to make up this science. But he wishes to indicate the important effect which this one piece of scientific knowledge has upon the work of shoveling.

At the works of the Bethlehem Steel Company, for example, as a result of this law, instead of allowing each shoveler to select and own his own shovel, it became necessary to provide some 8 to 10 different kinds of shovels, etc., each one appropriate to handling a given type of material; not only so as to enable the men to handle an average load of 21 pounds, but also to adapt the shovel to several other requirements which become perfectly evident when this work is studied as a science. A large shovel tool room was built, in which were stored not only shovels but carefully designed and standardized labor implements of all kinds, such as picks, crowbars, etc. This made it possible to issue to each workman a shovel which would hold a load of 21 pounds of whatever class of material they were to handle: a small shovel for ore, say, or a large one for ashes. Iron ore is one of the heavy materials which are handled in a works of this kind, and rice coal, owing to the fact that it is so slippery on the shovel, is one of the lightest materials. And it was found on studying the rule-of-thumb play at the Bethlehem Steel Company, where each shoveler owned his own shovel, that he would frequently go from shoveling ore, with a load of about 30 pounds per shovel, to handling rice coal, with a load on the same shovel of less than 4 pounds. In the one case, he was so overloaded that it was impossible for him to do a full day's work, and in the other case he was so ridiculously underloaded that it was manifestly impossible to even approximate a day's work.

Briefly to illustrate some of the other elements which go to make up the science of shoveling, thousands of stop-watch observations were made to study just how quickly a laborer, provided in each case with the proper type of shovel, can push his shovel into the pile of materials and then draw it out properly loaded. These observations were made first when pushing the shovel into the body of the pile. Next when shoveling on a dirt bottom, that is, at the outside edge of the pile, and next with a wooden bottom, and finally with an iron bottom. Again a similar accurate time study was made of the time required to swing the shovel backward and then throw the load for a given horizontal distance, accompanied by a given height. This time study was made for various combinations of distance and height. With data of this sort before him, coupled with the law of endurance, it is evident that the man who is directing shovelers can first teach them the exact methods which should be employed to use their strength to the very best advantage, and can then assign them daily tasks which are so just that the workman can each day be sure of earning the large bonus which is paid whenever he successfully performs this task.

There were about 600 shovelers and laborers of this general class in the yard of the Bethlehem Steel Company at this time. These men were scattered in their work over a yard which was, roughly, about two miles long and half a mile wide. In order that each workman should be given his proper implement and his proper instructions for doing each new job, it was necessary to establish a detailed system for directing men in their work, in place of the old plan of handling them in large groups, or gangs, under a few yard foremen. As each workman came into the works in the morning, he took out of his own special pigeonhole, with his number on the outside, two pieces of paper, one of which stated just what implements he was to get from the tool room and where he was to start to work, and the second of which gave the history of his previous day's work; that is, a statement of the work which he had done, how much he had earned the day before, etc. Many of these men were foreigners and unable to read and write, but they all knew at a glance the essence of this report, because yellow paper showed the man that he had failed to do his full task the day before, and informed him that he had not earned as much as $1.85 a day, and that none but high-priced men would be allowed to stay permanently with this gang. The hope was further expressed that he would earn his full wages on the following day. So that whenever the men received white slips they knew that everything was all right, and whenever they received yellow slips they realized that they must do better or they would be shifted to some other class of work.

Dealing with every workman as a separate individual in this way involved the building of a labor office for the superintendent and clerks who were in charge of this section of the work. In this office every laborer's work was planned out well in advance, and the workmen were all moved from place to place by the clerks with elaborate diagrams or maps of the yard before them, very much as chessmen are moved on a chess-board, a telephone and messenger system having been installed for this purpose. In this way a large amount of the time lost through having too many men in one place and too few in another, and through waiting between jobs, was entirely eliminated. Under the old system the workmen were kept busy day after day in comparatively large gangs, each under a single foreman, and the gang was apt to remain of pretty nearly the same size whether there was much or little of the particular kind of work on hand which this foreman had under his charge, since each gang had to be kept large enough to handle whatever work in its special line was likely to come along.

When one ceases to deal with men in large gangs or groups, and proceeds to study each workman as an individual, if the workman fails to do his task, some competent teacher should be sent to show him exactly how his work can best be done, to guide, help, and encourage him, and, at the same time, to study his possibilities as a workman. So that, under the plan which individualizes each workman, instead of brutally discharging the man or lowering his wages for failing to make good at once, he is given the time and the help required to make him proficient at his present job, or he is shifted to another class of work for which he is either mentally or physically better suited.

All of this requires the kindly coöperation of the management, and involves a much more elaborate organization and system than the old-fashioned herding of men in large gangs. This organization consisted, in this case, of one set of men, who were engaged in the development of the science of laboring through time study, such as has been described above; another set of men, mostly skilled laborers themselves, who were teachers, and who helped and guided the men in their work; another set of toolroom men who provided them with the proper implements and kept them in perfect order, and another set of clerks who planned the work well in advance, moved the men with the least loss of time from one place to another, and properly recorded each man's earnings, etc. And this furnishes an elementary illustration of what has been referred to as coöperation between the management and the workmen.

The question which naturally presents itself is whether an elaborate organization of this sort can be made to pay for itself; whether such an organization is not top-heavy. This question will best be answered by a statement of the results of the third year of working under this plan.

	Old Plan	New Plan Task Work
The number of yard laborers was reduced from between	400 and 600 down to about	140
Average number of tons per man per day............	16	59
Average earnings per man per day................	$1.15	$ 1.88
Average cost of handling a ton of 2240 lbs	$0.072	$0.033

And in computing the low cost of $0.033 per ton, the office and tool-room expenses, and the wages of all labor superintendents, foremen, clerks, time-study men, etc., are included.

During this year the total savings of the new plan over the old amounted to $36,417.69, and during the six months following, when all of the work of the yard was on task work, the saving was at the rate of between $75,000 and $80,000 per year.

Perhaps the most important of all the results attained was the effect on the workmen themselves. A careful inquiry into the condition of these men developed the fact that out of the 140 workmen only two were said to be drinking men. This does not, of course, imply that many of them did not take an occasional drink. The fact is that a steady drinker would find it almost impossible to keep up with the pace which was set, so that they were practically all sober. Many, if not most of them, were saving money, and they all lived better than they had before. These men constituted the finest body of picked laborers that the writer has ever seen together, and they looked upon the men who were over them, their bosses and their teachers, as their very best friends; not as nigger drivers, forcing them to work extra hard for ordinary wages, but as friends who were teaching them and helping them to earn much higher wages than they had ever earned before. It would have been absolutely impossible for anyone to have stirred up strife between these men and their employers. And this presents a very simple though effective illustration of what is meant by the words "prosperity for the employee, coupled with prosperity for the employer," the two principal objects of management. It is evident also that this result has been brought about by the application of the four fundamental principles of scientific management.

The illustrations have thus far been purposely confined to the more elementary types of work, so that a very strong doubt must still remain as to whether this kind of coöperation is desirable in the case of more intelligent mechanics, that is, in the case of men who are more capable of generalization, and who would therefore be more likely, of their own volition, to choose the more scientific and better methods. The following illustrations will be given for the purpose of demonstrating the fact that in the higher classes of work the scientific laws which are developed are so intricate that the high-priced mechanic needs (even more than the cheap laborer) the coöperation of men better educated than himself in finding the laws, and then in selecting, developing, and training him to work in accordance with these laws. These illustrations should make perfectly clear our original proposition that in practically all of the mechanic arts the science which underlies each workman's act is so great and amounts to so much that the workman who is best suited to actually doing the work is incapable, either through lack of education or through insufficient mental capacity, of understanding this science.

A doubt, for instance, will remain in the minds perhaps of most readers (in the case of an establishment which manufactures the same machine, year in and year out, in large quantities, and in which, therefore, each mechanic repeats the same limited series of operations over and over again), whether the ingenuity of each workman and the help which he from time to time receives from his foreman will not develop such superior methods and such a personal dexterity that no scientific study which could be made would result in a material increase in efficiency.

A number of years ago a company employing about three hundred men, which had been manufacturing the same machine for ten to fifteen years, sent for us to report as to whether any gain could be made through the introduction of scientific management. Their shops had been run for many years under a good superintendent and with excellent foremen and workmen, on piece work. The whole establishment was, without doubt, in better physical condition than the average machine-shop in this country. The superintendent was distinctly displeased when told that through the adoption of task management the output, with the same number of men and machines, could be more than doubled. He said that he believed that any such statement was mere boasting, absolutely false, and instead of inspiring him with confidence, he was disgusted that any one should make such an impudent claim. He, however, readily assented to the proposition that he should select any one of the machines whose output he considered as representing the average of the shop, and that we should then demonstrate on this machine that through scientific methods its output could be more than doubled.

The machine selected by him fairly represented the work of the shop. It had been run for ten or twelve years past by a first-class mechanic who was more than equal in his ability to the average workmen in the establishment. In a shop of this sort, in which similar machines are made over and over again, the work is necessarily greatly subdivided, so that no one man works upon more than a comparatively small number of parts during the year. A careful record was therefore made, in the presence of both parties, of the time actually taken in finishing each of the parts which this man worked upon. The total time required by him to finish each piece, as well as the exact speeds and feeds which he took, were noted, and a record was kept of the time which he took in setting the work in the machine and removing it. After obtaining in this way a statement of what represented a fair average of the work done in the shop, we applied to this one machine the principles of scientific management.

By means of four quite elaborate slide-rules, which have been especially made for the purpose of determining the all-round capacity of metal-cutting machines, a careful analysis was made of every element of this machine in its relation to the work in hand. Its pulling power at its various speeds, its feeding capacity, and its proper speeds, were determined by means of the slide-rules, and changes were then made in the countershaft and driving pulleys so as to run it at its proper speed. Tools, made of high-speed steel, and of the proper shapes, were properly dressed, treated, and ground. (It should be understood, however, that in this case the high-speed steel which had heretofore been in general use in the shop was also used in our demonstration.) A large special slide-rule was then made, by means of which the exact speeds and feeds were indicated at which each kind of work could be done in the shortest possible time in this particular lathe. After preparing in this way so that the workman should work according to the new method, one after another, pieces of work were finished in the lathe, corresponding to the work which had been done in our preliminary trials, and the gain in time made through running the machine according to scientific principles ranged from two and one-half times the speed in the slowest instance to nine times the speed in the highest.

The change from rule-of-thumb management to scientific management involves, however, not only a study of what is the proper speed for doing the work and a remodeling of the tools and the implements in the shop, but also a complete change in the mental attitude of all the men in the shop toward their work and toward their employers. The physical improvements in the machines necessary to insure large gains, and the motion study followed by minute study with a stop-watch of the time in which each workman should do his work, can be made comparatively quickly. But the change in the mental attitude and in the habits of the three hundred or more workmen can be brought about only slowly and through a long series of object-lessons, which finally demonstrates to each man the great advantage which he will gain by heartily coöperating in his every-day work with the men in the management. Within three years, however, in this shop, the output had been more than doubled per man and per machine. The men had been carefully selected and in almost all cases promoted from a lower to a higher order of work, and so instructed by their teachers (the functional foremen) that they were able to earn higher wages than ever before. The average increase in the daily earnings of each man was about 35 per cent, while, at the same time, the sum total of the wages paid for doing a given amount of work was lower than before. This increase in the speed of doing the work, of course, involved a substitution of the quickest hand methods for the old independent rule-of-thumb methods, and an elaborate analysis of the hand work done by each man. (By hand work is meant such work as depends upon the manual dexterity and speed of a workman, and which is independent of the work done by the machine.) The time saved by scientific hand work was in many cases greater even than that saved in machine-work.

It seems important to fully explain the reason why, with the aid of a slide-rule, and after having studied the art of cutting metals, it was possible for the scientifically equipped man, who had never before seen these particular jobs, and who had never worked on this machine, to do work from two and one-half to nine times as fast as it had been done before by a good mechanic who had spent his whole time for some ten to twelve years in doing this very work upon this particular machine. In a word, this was possible because the art of cutting metals involves a true science of no small magnitude, a science, in fact, so intricate that it is impossible for any machinist who is suited to running a lathe year in and year out either to understand it or to work according to its laws without the help of men who have made this their specialty. Men who are unfamiliar with machine-shop work are prone to look upon the manufacture of each piece as a special problem, independent of any other kind of machine-work. They are apt to think, for instance, that the problems connected with making the parts of an engine require the especial study, one may say almost the life study, of a set of engine-making mechanics, and that these problems are entirely different from those which would be met with in machining lathe or planer parts. In fact, however, a study of these elements which are peculiar either to engine parts or to lathe parts is trifling, compared with the great study of the art, or science, of cutting metals, upon a knowledge of which rests the ability to do really fast machine-work of all kinds.

The real problem is how to remove chips fast from a casting or a forging, and how to make the piece smooth and true in the shortest time, and it matters but little whether the piece being worked upon is part, say, of a marine engine, a printing-press, or an automobile. For this reason, the man with the slide-rule, familiar with the science of cutting metals, who had never before seen this particular work, was able completely to distance the skilled mechanic who had made the parts of this machine his specialty for years.

The development of the art or science of cutting metals is an apt illustration of this fact. In the fall of 1880, about the time that the writer started to make the experiments above referred to, to determine what constitutes a proper day's work for a laborer, he also obtained the permission of Mr. William Sellers, the president of the Midvale Steel Company, to make a series of experiments to determine what angles and shapes of tools were the best for cutting steel, and also to try to determine the proper cutting speed for steel. At the time that these experiments were started it was his belief that they would not last longer than six months, and, in fact, if it had been known that a longer period than this would be required, the permission to spend a considerable sum of money in making them would not have been forthcoming.

A 66-inch diameter vertical boring-mill was the first machine used in making these experiments, and large locomotive tires, made out of hard steel of uniform quality, were day after day cut up into chips in gradually learning how to make, shape, and use the cutting tools so that they would do faster work. At the end of six months sufficient practical information had been obtained to far more than repay the cost of materials and wages which had been expended in experimenting. And yet the comparatively small number of experiments which had been made served principally to make it clear that the actual knowledge attained was but a small fraction of that which still remained to be developed, and which was badly needed by us, in our daily attempt to direct and help the machinists in their tasks.

Experiments in this field were carried on, with occasional interruption, through a period of about 26 years, in the course of which ten different experimental machines were especially fitted up to do this work. Between 30,000 and 50,000 experiments were carefully recorded, and many other experiments were made, of which no record was kept. In studying these laws more than 800,000 pounds of steel and iron was cut up into chips with the experimental tools, and it is estimated that from $150,000 to $200,000 was spent in the investigation.

Work of this character is intensely interesting to any one who has any love for scientific research. For the purpose of this paper, however, it should be fully appreciated that the motive power which kept these experiments going through many years, and which supplied the money and the opportunity for their accomplishment, was not an abstract search after scientific knowledge, but was the very practical fact that we lacked the exact information which was needed every day, in order to help our machinists to do their work in the best way and in the quickest time.

All of these experiments were made to enable us to answer correctly the two questions which face every machinist each time that he does a piece of work in a metal-cutting machine, such as a lathe, planer, drill press, or milling machine. These two questions are:

In order to do the work in the quickest time,

At what cutting speed shall I run my machine? and

What feed shall I use?

They sound so simple that they would appear to call for merely the trained judgment of any good mechanic. In fact, however, after working 26 years, it has been found that the answer in every case involves the solution of an intricate mathematical problem, in which the effect of twelve independent variables must be determined.

After these laws had been investigated and the various formulae which mathematically expressed them had been determined, there still remained the difficult task of how to solve one of these complicated mathematical problems quickly enough to make this knowledge available for every-day use. If a good mathematician who had these formulae before him were to attempt to get the proper answer (i.e., to get the correct cutting speed and feed by working in the ordinary way) it would take him from two to six hours, say, to solve a single problem; far longer to solve the mathematical problem than would be taken in most cases by the workmen in doing the whole job in his machine. Thus a task of considerable magnitude which faced us was that of finding a quick solution of this problem, and as we made progress in its solution, the whole problem was from time to time presented by the writer to one after another of the noted mathematicians in this country. They were offered any reasonable fee for a rapid, practical method to be used in its solution. Some of these men merely glanced at it; others, for the sake of being courteous, kept it before them for some two or three weeks. They all gave us practically the same answer: that in many cases it was possible to solve mathematical problems which contained four variables, and in some cases problems with five or six variables, but that it was manifestly impossible to solve a problem containing twelve variables in any other way than by the slow process of "trial and error."

A quick solution was, however, so much of a necessity in our every-day work of running machine-shops, that in spite of the small encouragement received from the mathematicians, we continued at irregular periods, through a term of fifteen years, to give a large amount of time searching for a simple solution. Four or five men at various periods gave practically their whole time to this work, and finally, while we were at the Bethlehem Steel Company, the slide-rule was developed which is illustrated on Folder No. 11 of the paper "On the Art of Cutting Metals," and is described in detail in the paper presented by Mr. Carl G. Barth to the American Society of Mechanical Engineers, entitled "Slide-rules for the Machine-shop, as a part of the Taylor System of Management" (Vol. XXV of The Transactions of the American Society of Mechanical Engineers). By means of this slide-rule, one of these intricate problems can be solved in less than a half minute by any good mechanic, whether he understands anything about mathematics or not, thus making available for every-day, practical use the years of experimenting on the art of cutting metals.

This is a good illustration of the fact that some way can always be found of making practical, every-day use of complicated scientific data, which appear to be beyond the experience and the range of the technical training of ordinary practical men. These slide-rules have been for years in constant daily use by machinists having no knowledge of mathematics.

Now, when through all of this teaching and this minute instruction the work is apparently made so smooth and easy for the workman, the first impression is that this all tends to make him a mere automaton, a wooden man. As the workmen frequently say when they first come under this system, "Why, I am not allowed to think or move without someone interfering or doing it for me!" The same criticism and objection, however, can be raised against all other modern subdivision of labor. It does not follow, for example, that the modern surgeon is any more narrow or wooden a man than the early settler of this country. The frontiersman, however, had to be not only a surgeon, but also an architect, house-builder, lumberman, farmer, soldier, and doctor, and he had to settle his law cases with a gun. You would hardly say that the life of the modern surgeon is any more narrowing, or that he is more of a wooden man than the frontiersman. The many problems to be met and solved by the surgeon are just as intricate and difficult and as developing and broadening in their way as were those of the frontiersman.

And it should be remembered that the training of the surgeon has been almost identical in type with the teaching and training which is given to the workman under scientific management. The surgeon, all through his early years, is under the closest supervision of more experienced men, who show him in the minutest way how each element of his work is best done. They provide him with the finest implements, each one of which has been the subject of special study and development, and then insist upon his using each of these implements in the very best way. All of this teaching, however, in no way narrows him. On the contrary he is quickly given the very best knowledge of his predecessors; and, provided (as he is, right from the start) with standard implements and methods which represent the best knowledge of the world up to date, he is able to use his own originality and ingenuity to make real additions to the world's knowledge, instead of reinventing things which are old. In a similar way the workman who is coöperating with his many teachers under scientific management has an opportunity to develop which is at least as good as and generally better than that which he had when the whole problem was "up to him" and he did his work entirely unaided.

If it were true that the workman would develop into a larger and finer man without all of this teaching, and without the help of the laws which have been formulated for doing his particular job, then it would follow that the young man who now comes to college to have the help of a teacher in mathematics, physics, chemistry, Latin, Greek, etc., would do better to study these things unaided and by himself. The only difference in the two cases is that students come to their teachers, while from the nature of the work done by the mechanic under scientific management, the teachers must go to him. What really happens is that, with the aid of the science which is invariably developed, and through the instructions from his teachers, each workman of a given intellectual capacity is enabled to do a much higher, more interesting, and finally more developing and more profitable kind of work than he was before able to do. The laborer who before was unable to do anything beyond, perhaps, shoveling and wheeling dirt from place to place, or carrying the work from one part of the shop to another, is in many cases taught to do the more elementary machinist's work, accompanied by the agreeable surroundings and the interesting variety and higher wages which go with the machinist's trade. The cheap machinist or helper, who before was able to run perhaps merely a drill press, is taught to do the more intricate and higher priced lathe and planer work, while the highly skilled and more intelligent machinists become functional foremen and teachers. And so on, right up the line.

It may seem that with scientific management there is not the same incentive for the workman to use his ingenuity in devising new and better methods of doing the work, as well as in improving his implements, that there is with the old type of management. It is true that with scientific management the workman is not allowed to use whatever implements and methods he sees fit in the daily practice of his work. Every encouragement, however, should be given him to suggest improvements, both in methods and in implements. And whenever a workman proposes an improvement, it should be the policy of the management to make a careful analysis of the new method, and if necessary conduct a series of experiments to determine accurately the relative merit of the new suggestion and of the old standard. And whenever the new method is found to be markedly superior to the old, it should be adopted as the standard for the whole establishment. The workman should be given the full credit for the improvement, and should be paid a cash premium as a reward for his ingenuity. In this way the true initiative of the workmen is better attained under scientific management than under the old individual plan.

RESIGNATION OF PRESIDENT STEWARDSON

Before this bulletin went to press, President Stewardson's letter of resignation was received by the Trustees and it is therefore printed here:

MENAGGIO, ITALY, July 27th, 1912.

To Douglas Merritt, Esq., and the Board of Trustees of
Hobart College:

Dear Sirs:

I am greatly distressed to report that Mrs. Stewardson's health is still in a precarious condition. Within the past few weeks she has once more grown worse and the need of a more prolonged stay abroad arisen. I have already postponed our date of sailing from September 10th to October 19th and I may yet be compelled to make other postponements. Even should we be able to take the steamer on October 19th I could not report for duty in Geneva before November, as physicians have to be consulted in New York and arrangements made for my wife's winter home. It is practically certain that she will not be able to return to Geneva and resume her duties there this academic year.

Under all these circumstances it has become perfectly clear that my duty to Hobart College compels me to at once resign the office of president with which you honored me in January, 1903. It is needless to say that this resolution has been reached with difficulty and taken in deep distress. After almost ten years of hard labor and when the goal of all my efforts is in sight, the *finish* I am making is a heartbreaking one. But the good conduct of the affairs of the College requires the constant care and supervision of a leader forever on the ground. No Acting-President has his authority and no Board of Trustees, however competent, is near enough to the college life or sufficiently in touch with its many diverse elements to take his place.

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It is therefore my firm conviction that the Trustees should move without delay to secure such a leader. I have made every effort, sorely wounded as I have been, to stand by the ship but I am now in the cockpit and in no condition to fill my position on the quarter-deck. The sooner a new captain is put in this position the better it will be for the College; and in order to provide a place for him I surrender my command and give into your hands my final resignation to take effect on September 30th. I name this date because it is the end of the present quarter and because it is within a very few days of the time on which my return was expected. It has the further advantage of saving to the College for some months to come the President's salary.

Far be it from me to parade the grief I feel in saying good-bye, but I cannot part from you and my colleagues of the faculty, together with the students and alumni of Hobart and William Smith Colleges without giving you all some reason to suspect that beneath the cold words of this formal letter there is a heartfelt joy at having been in a position to serve for so long the institution of whose interests you of the trustees are the appointed guardians, and an equally heartfelt sorrow in the broken opportunity of serving it and you any longer.

With fond memories of the past and bright hopes for the future of Hobart and William Smith believe me with both appreciation and regard,

Respectfully yours,

LANGDON C. STEWARDSON.

P. S.—It would be a personal satisfaction to me if, with your approval, this letter could be published in full and for two reasons. The first is that I should like every one to know the grounds on which I have felt myself forced to reluctantly retire from my post, and the second, a no less cogent one, is that I should also like every one to know—my boys and girls and my faculty as well as the trustees and alumni of both Colleges that I bear you one and all in my heart.